

PATENT COOPERATION TREATY

PCT

REC'D 28 SEP 2005

WIPO

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P2126PC00	FOR FURTHER ACTION See Form PCT/IPEA/416	
International application No. PCT/NO2004/000172	International filing date (day/month/year) 11.06.2004	Priority date (day/month/year) 23.06.2003
International Patent Classification (IPC) or national classification and IPC F03B13/18, 13/20		
Applicant Fobox AS c/o Fred Olsen et al		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 8 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
- a. ☒ (sent to the applicant and to the International Bureau) a total of 6 sheets, as follows:
- ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
- ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
- b. ☐ (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) _____, containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:
- ☒ Box No. I Basis of the report
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☒ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

Date of submission of the demand 20.04.2005	Date of completion of this report 20.09.2005
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. +46 8 667 72 88	Authorized officer Daniel Åberg / JA A Telephone No. +46 8 782 25 00

Form PCT/IPEA/409 (cover sheet) (April 2005)

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/NO2004/000172

Box No. I Basis of the report

1. With regard to the language, this report is based on:



the international application in the language in which it was filed

a translation of the international application into _____,
which is the language of a translation furnished for the purposes of:

international search (Rules 12.3(a) and 23.1(b))



publication of the international application (Rule 12.4(a))



international preliminary examination (Rules 55.2(a) and/or 55.3(a))

2. With regard to the elements of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

the international application as originally filed/furnished



the description:

pages 1-8, 10-16

as originally filed/furnished

pages* 9received by this Authority on 20.04.2005

pages* _____

received by this Authority on _____



the claims:

pages _____

as originally filed/furnished

pages* _____

as amended (together with any statement) under Article 19

pages* 17-21received by this Authority on 20.04.2005

pages* _____

received by this Authority on _____



the drawings:

pages 1-12

as originally filed/furnished

pages* _____

received by this Authority on _____

pages* _____

received by this Authority on _____



a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

the description, pages _____



the claims, Nos. _____



the drawings, sheets/figs _____

the sequence listing (*specify*): _____any table(s) related to the sequence listing (*specify*): _____4. ☒ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

the description, pages _____

the claims, Nos. 1-7, 15-18, 23-25

the drawings, sheets/figs _____

the sequence listing (*specify*): _____any table(s) related to the sequence listing (*specify*): _____

* If item 4 applies, some or all of those sheets may be marked "superseded."

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: BOX I

It is clear from the application as filed (see page 2, line 1-line 5 and all of the original independent claims 1, 13 and 14) that the primary object of the present invention is to increase the output of energy from the wave power plant by arranging a floating body to be locked in place during part of the wave induced motion of the body, thereby increasing the energy recovery from the waves. These features are essential to the definition of the invention and consequently the search has been performed on such wave power plants. The amended claims 1-7 are considered by the applicant to be based on and supported by the embodiments of figures 8-10 and the description pages 13 and 14. However, since none of the amended claims 1-7, 15-18 (when dependent on anyone of the claims 1-7) and 23-25 contain said essential features of the invention, said amended claims are considered to go beyond the disclosure of the application as filed. Consequently, this report has been established as if the amendments had not been made; see PCT Rule 70.2(c).

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/NO2004/000172

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	<u>3-7, 8-14, 16, 17, 21, 22</u>	YES
	Claims	<u>1, 2, 15, 19, 20</u>	NO
Inventive step (IS)	Claims		YES
	Claims	<u>1-17, 19-22</u>	NO
Industrial applicability (IA)	Claims	<u>1-17, 19-22</u>	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

Claims 1-7, 15-17 as originally filed:

Reference is made to the following documents:

D1: US 4355511 A

D2: GB 2131887 A

D3: US 4931662 A

D1 discloses (see fig. 15A-17 and 27-29D) a wave power plant comprising a floating structure and at least one floating body (340) that moves vertically relative to the floating structure and is connected to the structure via energy transmission devices. The floating body (340) is designed to be retained both in a lower position and in an upper position of the wave induced motion of the body, thereby increasing the energy recovery from the waves (see abstract; column 2, line 39-column 3, line 4; column 18, line 6-column 20, line 21 and column 25, line 66-column 27, line 22). Hence, the subject-matter of claims 1 and 2 lacks novelty and consequently also an inventive step.

D1 is regarded as being the closest prior art to the subject-matter of claims 3-7 and 16. The subject-matter of claims 3-7 and 16 differs from the wave power plant disclosed in D1 in that the floating body is designed to be partially filled with water and that the amount of water in the floating body can be adjusted through means provided on the body. The problem to be solved by the present invention may therefore be regarded as that of creating a wave power plant with means for allowing the natural frequency of the floating bodies to be matched to the wave period. D3 discloses (see fig. 7 and 8) a similar wave power plant

.../...

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: Box V

provided with such means on its floating body (see column 5, line 27-line 48). Since this feature of adjusting the amount of water in a floating body is described in document D3 as providing the same advantages as in the present application. The skilled person would therefore regard it as a normal design option to include this feature on the wave power plant described in document D1 in order to solve the problem posed. Hence, the subject-matter of claims 3-7 and 16 is not considered to involve an inventive step.

The subject-matter of claim 15 is disclosed in D1 (see column 6, line 26-line 39, fig. 1B and column 1, line 43-line 51). Hence, the subject-matter of claim 15 lacks novelty and consequently also an inventive step.

The subject-matter of claim 17 differs from the wave power plant disclosed in D1 in that the floating structure can be raised or lowered through ballasting. Ballasting is a well known technique in order to raise or lower a floating structure and the skilled person would therefore regard it as a normal design option to include this feature on the wave power plant described in document D1 in order to achieve optimum wave motion through or around the structure (especially if the depth of submersion of the floating body is altered (see claim 3-7 and 16 above)).

Claims 8-14 and 19-22 received by this Authority on 20.04.2005:

Reference is made to the following documents:

D1: US 4355511 A

D2: US 4931662 A

D1 is regarded as being the closest prior art to the subject-matter of claim 8 (see abstract; column 2, line 39-column 3, line 4; column 18, line 6-column 20, line 21; column 25, line 66-column 27, line 22 and fig. 15A-17 and 27-29D). The subject-matter of claim 8 differs from the wave power plant disclosed in D1 in that the floating body is designed to be partially filled with water.

.../...

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: BOX V

The problem to be solved by the present invention may therefore be regarded as that of creating a wave power plant with means for allowing the natural frequency of the floating bodies to be matched to the wave period.

D2 discloses (see fig. 7 and 8) a similar wave power plant provided with such means on its floating body (see column 5, line 27-line 48). Since this feature of adjusting the amount of water in a floating body is described in document D2 as providing the same advantages as in the present application. The skilled person would therefore regard it as a normal design option to include this feature on the wave power plant described in document D1 in order to solve the problem posed. Hence, the subject-matter of claim 8 is not considered to involve an inventive step.

The dependent claims 9-14 are considered to involve particular detail executions obvious to a person skilled in the art. Therefore, the invention according to these claims is not considered to involve an inventive step.

The subject-matter of claims 19 and 20 (disregarding the unclear statement [see box VIII]) appears to be disclosed in D1 (besides previously mentioned text passages, see also fig. 1A-1C, column 6, line 9-line 39 and column 9, line 20-line 34). Hence, the subject-matter of claims 19 and 20 appears to lack novelty and consequently also an inventive step.

The remaining claims 21 and 22 (see also box VIII) are considered to involve particular detail executions obvious to a person skilled in the art. Therefore, the invention according to these claims is not considered to involve an inventive step.

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/NO2004/000172

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

In claim 9 feature "through" should be corrected to "trough".

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

Claims 19 and 20 contain an unclear statement, namely that "the maximum deflection of the floating body (natural frequency) is close to the wave period". It is unclear how a length parameter ("maximum deflection") and a time parameter ("wave period") can be compared with each other, i.e. when one parameter "is close" to the other, thereby rendering the definition of the subject-matter of said claims unclear (Article 6 PCT).

The method according to claim 22 cannot refer to "any of the preceding claims", since most of the preceding claims are aimed at a wave power plant (apparatus claims). Claim 22 is interpreted, in box V, to refer to a method according to any of the preceding claims 19-21. Hence, the preamble of claim 22 must be corrected.

The formula is based on a floating body having an oblong shape with rounded ends, in the main as shown in Figure 1.

- 5 If the floating body is retained and released as described above in connection with Figure 4, the formula (2) will apply:

$$(2) \quad E = K_1 (H_s/T_P) \cdot (K_2 D_P + K_3 P)$$

- 10 where:

E is the output in kilowatts

H_s is the significant wave height, measured in metres

T_P is the wave period, measured in seconds

D_P is the displacement of the floating body, measured in tons

- 15 P is the retaining power upon release of the body, measured in tons

K_1 is a constant of approximately 10

K_2 is a parameter approximately equal to RAO (Response Amplitude Operator), which will be equal to 1 if the movement of the body follows that of the waves.

K_3 is a constant which ideally is approximately equal to 2.5, but which may be between

- 20 1 and 3.

The term $K_3 P$ in the formula (2) is the contribution from holding the floating body back until the wave has given the body a maximum upward force, before releasing the body.

- 25 This term can be said to represent an additional displacement of the body. It has been found that the sum of the displacement of the body caused by the net weight of the body and the additional displacement resulting from the body being retained, should not exceed $V \cdot \rho$, where V is the total volume of the floating body and ρ is the specific weight of the water. If this value is exceeded, the energy output may be reduced. Another condition is that the water must not rise above the top of the body.

- 30

Example:

N e w P a t e n t C l a i m s

Agent's ref.: P2126PC00

Appln. No.: PCT/NO04/00172

1.

5 A wave power plant designed to be arranged on or in the sea or a lake in order to produce energy, comprising a floating structure and at least one floating body that moves vertically relative to the floating structure and is connected to the structure via energy transmission devices, c h a r a c t e r i z e d i n that the floating structure comprises a deck which is supported by substantially vertical columns, the columns having a pontoon or
10 dampener adapted to be situated substantially below water level; the deck, columns and pontoon or dampener defining a space within which the floating body or bodies are situated.

2.

15 A wave power plant according to claim 1, c h a r a c t e r i z e d i n that the diameter of the columns is substantially equal to the diameter of the floating body or bodies.

3.

20 A wave power plant according to claim 1 or 2, c h a r a c t e r i z e d i n that the pontoons have a substantially square cross section with a width larger than the height.

4.

25 A wave power plant according to claim 3, c h a r a c t e r i z e d i n that the pontoons have substantially sharp corners.

5.

30 A wave power plant according to claim 1, c h a r a c t e r i z e d i n that the dampener is adapted to trap water when the structure is moving due to wave induction and re-direct water flowing substantially vertical to a substantially horizontal flow.

2 0 -04- 2005

6.

A wave power plant according to claim 5, c h a r a c t e r i z e d i n ..
that the columns are open at their lower end so that water may flow into the column and out
of the wave dampener when the structure is moving downward relative to the water.

7.

A wave power plant according to claim 5 or 6, c h a r a c t e r i z e d
i n that the wave dampeners at their upper and/or lower ends have a curvature that re-
directs water.

8.

A wave power plant designed to be arranged on or in the sea or a lake in order to produce
energy, comprising a floating structure and at least one floating body that moves vertically
relative to the floating structure and is connected to the structure via energy transmission
devices, c h a r a c t e r i z e d i n that the floating body or bodies
is/are designed to be retained during parts of the wave induced motion of the body, thus to
increase the energy recovery from the waves and that the floating bodies are designed to be
partially filled with water.

9.

A wave power plant according to Claim 8, c h a r a c t e r i z e d i n
that the floating body is designed to be retained both in a lower position and in an upper
position, which lower position is such that a wave crest exerts an upward force on the floating
body which is greater than the weight of the body, and the upper position is such that the
weight of the body acts with a downward force that is greater than the power effected by a
through.

10.

A wave power plant according to Claim 8 or 9, c h a r a c t e r i z e d
i n that the floating bodies comprise means of increasing or reducing the amount of water
in the floating bodies.

20 -04- 2005

11.

A wave power plant according to Claim 10, c h a r a c t e r i z e d i n that the means comprise an opening at the lower end of the floating body.

5 12.

A wave power plant according to Claim 11, c h a r a c t e r i z e d i n that the means also comprise a closable opening at the upper end of the floating body.

13.

10 A wave power plant according to Claim 11, c h a r a c t e r i z e d i n that the means also comprise an adjustable extension of the floating body, which extension is arranged to receive water.

14.

15 A wave power plant according to one of the preceding claims 8 - 13, c h a r a c t e r i z e d i n that the floating structure comprises truss work in which there are defined chambers designed to hold respective floating bodies.

15.

20 A wave power plant according to one of the preceding claims, c h a r a c t e r i z e d i n that the floating bodies are supported on a guide rail that is fixed in the structure.

16.

25 A wave power plant according to Claim 14 or 15, c h a r a c t e r i z e d i n that the truss work comprises pipes made from a lightweight material, preferably plastic.

17.

30 A wave power plant according to one of the preceding claims, c h a r a c t e r i z e d i n that the floating body has the shape of a cylinder with rounded ends.

20 -04- 2005

18.

A wave power plant according to one of the preceding claims,

5 c h a r a c t e r i z e d i n that the floating structure comprises a base constructed with adjustable parts in order to build up the height of passing waves, so as to allow the energy to be transferred to surface waves, which impart more energy to the floating bodies.

19.

10 A method of increasing the energy production from a wave power plant comprising at least one floating body connected to a fixed or floating structure via energy transmission devices, c h a r a c t e r i z e d i n that the floating body is held in a fixed position relative to the structure during part of the period when a wave crest passes the floating body, and released while an upward force is exerted on the body from the wave, 15 which force is greater than the weight of the body, that the depth of submersion of the floating body is increased when the wave period increases, and that the depth of submersion is reduced in the case of shorter wave periods, such that the maximum deflection of the floating body (natural frequency) is close to the wave period.

20

20.

A method of increasing the energy production from a wave power plant comprising at least one floating body connected to a fixed or floating structure via energy transmission devices, c h a r a c t e r i z e d i n that the floating body is held in a fixed 25 position relative to the structure during part of the period when a trough passes the floating body, and released while the weight of the body is greater than the upward force from the wave acting on the body, that the depth of submersion of the floating body is increased when the wave period increases, and that the depth of submersion is reduced in the case of shorter wave periods, such that the maximum deflection of the floating body (natural frequency) is 30 close to the wave period.

21.

A method according to Claim 19 or 20, c h a r a c t e r i z e d i n that the increase or reduction in depth of submersion is achieved by lowering or raising the

floating body to the desired depth of submersion and allowing water to flow into or out of the floating body until the level of water inside the floating body is approximately the same as outside the floating body.

5 22.

A method according to any of the preceding claims, c h a r a c t e r i z e d i n that the draught of the floating structure can be raised or lowered through ballasting of the structure, in order to achieve optimum wave motion through or around the structure.

10 23.

A wave power plant designed to be arranged on or in the sea or a lake in order to produce energy, comprising a floating structure and at least one floating body that moves vertically relative to the floating structure and is connected to the structure via energy transmission devices, c h a r a c t e r i z e d i n that the floating body or bodies is/are adapted to float in the water surface and to be partially filled with water, and that the floating body or bodies comprise(s) an opening at the lower part of the body and a closable opening at the upper part of the body, the opening at the upper part is adapted to be opened to let water in or out through the opening at the lower part, to increase or reduce the amount of water in the floating body or bodies.

20

24.

A wave power plant designed to be arranged on or in the sea or a lake in order to produce energy, comprising a floating structure and at least one floating body that moves vertically relative to the floating structure and is connected to the structure via energy transmission devices, c h a r a c t e r i z e d i n that the floating body comprises an energy transmission device that is adapted to take up the energy from the vertical movement of the floating body and at least one energy transmission device that is adapted to take up energy resulting from horizontal forces acting on the body.

25

30 25.

A wave power plant according to Claim 24, c h a r a c t e r i z e d i n that the energy transmission devices are hydraulic cylinders.